

# Hybrid Power System for Power Quality Improvement and Security Analysis

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DOI: <https://doi.org/10.26438/ijcse/v7si10.107110> | Available online at: [www.ijcseonline.org](http://www.ijcseonline.org)

**Abstract**— The generation of electricity through renewable sources has exponentially increased in recent years in response to environmental pollution caused by fossil fuels. When we talk about renewable energy is difficult not to refer to solar energy, wind energy, biomass energy and Pedal generation due to its high rate of growth compared to their peers and potential. This is associated with the fact that the government is implementing a process of changing the production of energy and country's energy matrix where one of the fundamental pillars is to eliminate dependence on fossil resources and promote the use of renewable energy especially for rural areas. Therefore, this makes clear that it is important and needed to study the effects and possible problems related to renewable energy that entails the use of photovoltaic systems connected to the network with hybrid one like pedal system generation which is easily available. In this context, the work focuses on power quality by connecting photovoltaic to low-power electrical system with using solar and pedal generation simultaneously. Objective of this research based on other sources of energy i.e. renewable energy, because we have limited sources of non renewable sources of energy i. e. coal diesel, petrol etc. Energy crises need to search for other source of energy that is specifically renewable energy. Human power praise is more because of health benefit as a source of energy. And in this peoples are more aware to his health point of view. More effective use of human power could be achieved through properly design approach. Human power as prime mover used to operate working unit is termed as human powered machine (bicycle) and this machine is different from conventional bicycle because it can operate with different arrangement with the help of hand or leg or in special case with the help of animal power and in developed machine combination of gear arrangement and chain are used. In this paper two models are simulated one for solar energy and other for pedal energy both are the alternate sources of energy and easily available. In the developed system energy security is also maintained with continuity of supply with safe operation

**Keywords**— Power Quality, Power Filter, power electronic Controller, Harmonics Compensation, Total Harmonic Distortion

## I. INTRODUCTION

A hybrid power system consist two or more energy sources used together to provide increase system efficiency as well as greater balance in energy supply. Hybrid power systems are becoming more popular as standalone power system for providing electricity in remote areas [1]. i.e. hybrid power system (HPS) are autonomous electricity generating system that incorporate more than one type of power sources, operated together with associated supporting equipment include storage to provide electricity with the help of integration of different energy sources in one supply system, the technology of hybridization provides a perfect possibility to use locally available energy sources for supplying electric power in remote areas [2].

**The purpose of the research-** The statements are

- (a) To identify the hybrid energy sources to fulfil the future demand.
- (b) To investigate the hybrid power system with improved power quality.
- (c) To simulated the developed hybrid system for THD analysis.

## II. RELATED WORK

The objective of this paper to develop a MATLAB model for power generation from solar and pedal system (hybrid system) with improved efficiency. In recent years, renewable energy resources are utilized to meet the growing energy demand. The integration of renewable energy resources with the grid incorporates power electronic converters for conversion of energy. These power electronic converters introduce power quality issues such as a harmonics, voltage fluctuations etc. Hence, to improve the power quality issues,

this work proposes energy generation with control strategy for a solar and pedal power generation system. Total Harmonic Distortions is found using Fast Fourier Transform in MATLAB for solar and pedal hybrid system. The proposed system is validated through simulation using MATLAB/Simulink Power system toolbox and results are validate from the hardware effectiveness of the work but hardware parameters are small as compared to parameters selected to the design of MATLAB model .in this paper two models are simulated one for solar energy and other for pedal energy both are the alternate sources of energy and easily available.

**III. METHODOLOGY**

**(A) Proposed concept of pedal power**

Electricity is the basic requirement of all the people, the consumption of energy increases day by day. But production rate is not satisfactory according to the requirement. Due to these different types of problems occurs. i.e. unbalance of load and variation in electricity price. As pedal power is not a new idea but it has not been successfully adopted on a wider range. Pedal power systems were developed for different applications for small uses. It provides approximately 30 minutes of lighting for 10 minute of pedalling, and this provides great help especially for rural areas. With the help of this approach we can meet small demand for rural areas. Since cyclist legs are most efficient over a narrow range of pedalling speed (cadence), a variable gear ratio helps a cyclist to maintain an optimum pedalling speed while covering varied terrain

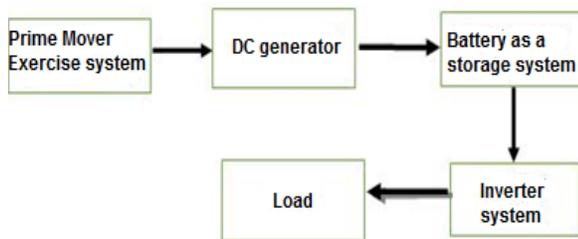


Figure-1.1 Proposed block diagram for pedal power system

**(B) Proposed concept for solar power-** the proposed concept of solar power the solar radiations are trapped with the help of solar panel the output of PV array is given to the boost converter. Which boost the output voltage of PV array this boosted voltage is applied to the filter to get the smooth output and the final stage this boosted smooth voltage are available to use for different applications. But there is one important task between the filter circuit and load i.e. voltage regulation which help to maintain the desired voltage. The basic work of the proposed model is to boost the voltage as per the requirement of the load.

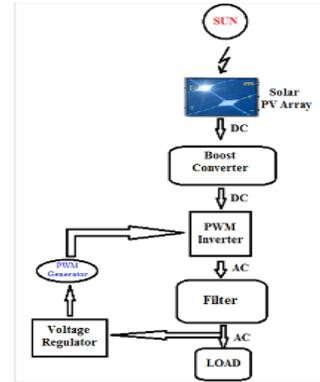


Figure-1.2 Proposed block diagram for solar power system

**IV. RESULTS AND DISCUSSION**

**(i) For solar power system**

Power quality in today’s world is an issue of significant importance to all customers at all usage of levels in both domestic and industrial environment. The awareness of good power quality is heightened because of use of sensitive and nonlinear equipment’s at common platform. If the network is working with poor power quality it may lead to failure or may reduce the lifetime of equipment. Power quality has been one of the latest research area due to exponentially growing demand in both private and public sectors .One of the complex issues in power quality analysis is that expatriation is required not only in one field but has to in many areas like power transmission drives ,transformers, switches ,harmonics etc. Thus for power quality analysis powerful tool is needed. In this research new topology of solar and pedal hybrid energy source is implemented using Matlab Simulink. The proposed system protects the sensitive load by mitigating the Harmonics, power quality analysis through THD shown with the help of graphs. In order to verify the effectiveness of the anticipated converter; the converter was designed in MATLAB/SIMULINK environment.

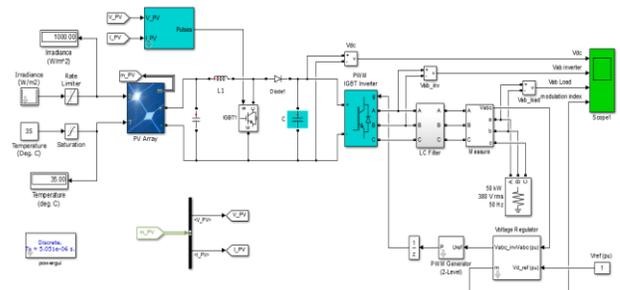


Figure- 1.3 Simulation diagram of solar based high boost ratio converter

Figure 1.3 represents Simulink model of solar based high boost ratio converter. In this input voltage is given to this converter by solar. The voltage is stepped up using a boost

converter and due to the capacitance  $C_o$  the ripples will be reduced and the fine DC voltage is obtained at the output side of the circuit.

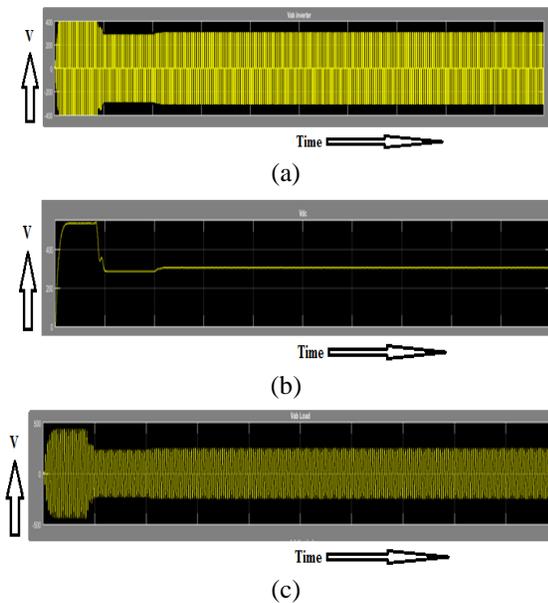


Figure- 1.4 Graph between (a) inverter voltages vs. time (b) DC voltage vs. time for solar based converter (c) Load voltage vs. time for solar based converter

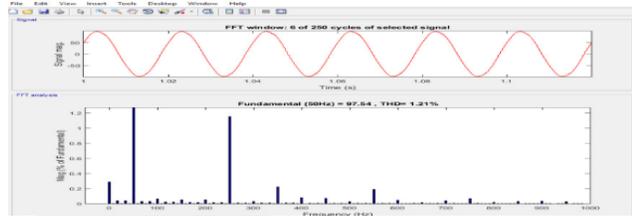


Figure- 1.5 output voltage waveform of solar based high boost ratio converter with THD analysis for Power Quality

In the fig. 1.4 & 1.5 graphs of solar based boost converter. Here, from the results we analysed that the by using solar there is sudden change in the voltage after some time. Now while we analyse the above result, we notice that while using the solar with boost converter there is increase in voltage for some time and then it reduces to particular voltage and there it saturates. Advantages and limitations of each source connected with boost converter are discussed further. Total harmonic distortion (THD) is the cumulative degree of distortion within an electrical signal. On a linear current sine curve, the peaks and troughs are smooth, even, and sinusoidal. But non linear loads results in harmonic distortion. According to IEEE standards 5% is maximum allowable THD limits. In the existing research and design of solar THD is calculated to be 1.21% shown in FFT. Thus present research fulfils IEEE standards for power quality analysis for solar system.

(ii) For pedal power system

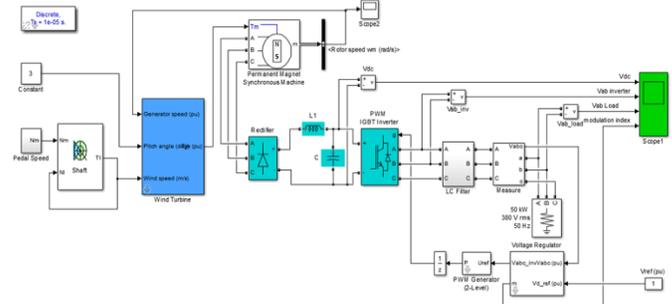


Figure- 1.6 Simulation diagram of pedal based high boost ratio converter

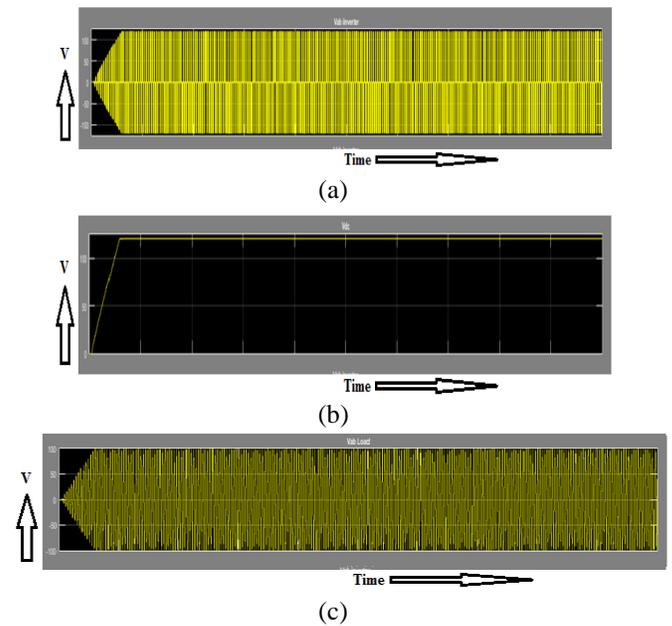


Figure- 1.7 Graph between (a) inverter voltages vs. time (b) DC voltage vs. time for solar based converter (c) load voltage vs. time for pedal based converter

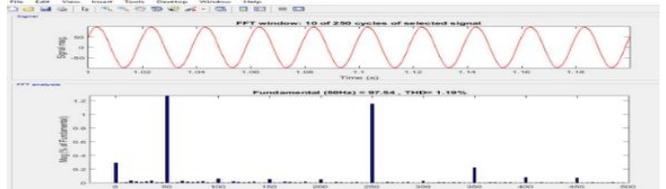


Figure- 1.8 output voltage waveform of pedal based high boost ratio converter with THD analysis for Power Quality

The fig.1.7 & 1.8 shows the pedal based boost converter is more significant and efficient than the solar based boost converter. As seen in solar based boost converter, here in pedal based boost converter gives smooth output. Also no such fluctuation in voltage as seen in solar based boost converter. There is no steep rise or steep fall in waveform

obtained from pedal based converter. Total harmonic distortion (THD) is the cumulative degree of distortion within an electrical signal. Most household electrical systems draw linear loads. On a linear current sine curve, the peaks and troughs are smooth, even, and sinusoidal. But non linear loads results in harmonic distortion. According to IEEE standards 5% is maximum allowable THD limits. In the existing research and design of Pedal Source energy THD is calculated to be 1.19% as shown in waveforms. Thus present research fulfils IEEE standards for power quality analysis.

Comparisons and advantages of solar-pedal hybrid system

#### Advantages

1. Developed system is more stable
2. Solar-pedal hybrid system is easily implemented anywhere.
3. Developed hybrid system is eco friendly there is no by product after operation.
4. Developed hybrid system can be used for health improvement purpose.
5. In developed system there is no consumption of fossil fuel.
6. Maintenance and operational cost is very low.
7. Detectable battery can be taken inside the house for different applications.
8. The reliability of the developed system is more.
9. The construction of developed model is robust.

## V. CONCLUSION AND FUTURE SCOPE

This research presents comparison between- different types of hybrid power system with new developed solar-pedal power hybrid with improved power quality and security analysis of system. The concept of achieving high efficiency due to reduction in voltage stresses on switch and compactness in the size is the main paradigm in the present day Power Electronic Industries. The main feature of the developed system is to maintain the power continuity with small investment especially for rural areas.

The demand for electric power is increasing at an exponential rate and at the same time the quality of power delivered became the most prominent issue in the power sector. Thus, the reduction of harmonics and improving the power factor of the system is of utmost important. In this research a model is developed with improve electric power quality by the use of gear arrangement system which is very useful and can be easily adopted for generation of electricity for our daily uses.

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